|  |  |
| --- | --- |
| Number of hours | Lecture Content |
| 1.0 | Introduction   * Basic soil physical properties and units * Representative elementary volume (scales) |
| 2.0 | The solid phase   * Soil texture and particle size distribution * Cumulative distribution functions and the soil particle size distribution * Specific surface * Soil structure and aggregation |
| 2.0 | Mass and Energy Transport in Soils   * Energy gradients/driving force in soils * Conservation of mass and energy * Continuity equation * Transport flux laws * Scale of transport processes; deterministic and stochastic processes/models |
| 8.0 | Soil Water – Equilibrium   * What is equilibrium? * Soil water potential (gravitational, matric, osmotic, pressure) * Capillarity and matric potential * The moisture retention curve and soil pore size distribution * Relationship between soil particle size distribution, soil structure and soil pore-size distribution |
| Soil Water – Steady State Saturated and Unsaturated Flow   * What is steady state? * Poiseuille's law for steady state flow in a capillary tube * Darcy’s law for steady sate flow in saturated soils * Saturated hydraulic conductivity and relationship between saturated hydraulic conductivity and the soil pore size distribution * The hydraulic conductivity curve and the soil pore size distribution/moisture retention curve * The Darcy-Buckingham Flux Law for variably saturated soils |
| Soil Water – Transient Soil Water Flow   * What is transient flow? * Derivation of the Richards Equation * Infiltration – a common transient soil water flow process * Soil- and precipitation-limiting infiltration * Redistribution and the field capacity concept * Soil-plant-atmosphere continuum and permanent wilting point * Plant-available water |
| 6.0 | Solute Transport – during steady state soil water flow   * Solutes, conservative and non-conservative solutes (retardation factor – R) * Soil water and aqueous solute velocity * Breakthrough curves and concentration profiles – step and pulse solute inputs * The solute travel time cumulative distribution function * Mean travel time and mean travel depth * Continuity equation and simple Solute Transport Equation |
| Solute Transport – Convection, diffusion, dispersion   * Convective stochastic versus convective dispersive models of solute transport * Stochastic stream tube models |
| 6.0 | Soil Aeration and Gas Transport   * Gas concentrations * Diffusion and convection * Air permeability * Gas transport equation |
| Soil Heat Transport and soil temperature regime   * Soil temperature * Soil thermal properties * Heat transport by conduction: Steady state heat transport – Fourier’s law * Transient heat transport – the heat equation * Soil water flow under temperature gradients * Coupled soil water and heat transport * Soil freezing and thawing – relationship of the soil freezing curve and the moisture retention curve |
| 7.0 | Simulation of soil transport processes   * Analytical solutions – boundary conditions, initial conditions * Numerical methods * uncertainty in soil transport parameters * spatial variability in soil transport parameters – vertical and horizontal heterogeneity |
| Simulation of 1-D infiltration |
| Simulation of soil temperature |
| Simulation of solute transport |
| Total = 32 |  |